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older work, that there is also a specific formative action of the blue rays as yet unexplainable on the nutrient basis.

He has often distinguished between the amount of carbon synthate and the amount of salt nutrients as formative factors in the plant, especially in connection with reproduction; and now FISCHER<sup>2</sup> makes this more definite by considering the nitrogen supply as the most important formative factor furnished by the salts, and by speaking of the carbon nitrogen ratio (C/N) of plants. He probably would not deny that the supply of other nutrient elements, phosphorus, calcium, potassium, etc., have at least minor formative effects and often of an opposite nature from nitrogen. This ratio can be increased by increasing the photosynthesis of the plants or by decreasing the nitrogen supply. The ratio can be decreased by decreasing photosynthesis or by increasing the nitrogen supply. FISCHER comes to this important conclusion. Very high C/N in plants favors flowering, while a low C/N favors vegetation. His conclusions are largely based on his own work on the effect of increased partial pressure of carbon dioxide upon the development of plants, but not upon chemical analysis of the tissues.

KRAUS and KRAYBILL<sup>3</sup> have recently worked upon the tomato, varying the C/N in it by varying its nitrogen supply. On the basis of extensive cultures and chemical, microchemical, and anatomical studies, they come to the following conclusions: (1) a very high C/N gives little vegetative growth and poor reproduction with a high percentage of dry matter; (2) medium C/N gives moderate vegetation growth, good reproduction, and a medium percentage of dry matter; (3) very low C/N gives very vigorous vegetative growth, little reproduction, and a low percentage of dry matter. KRAUS's extensive horticultural investigations enable him to give much evidence that the C/N ratio is a factor of great significance in determining fruitfulness in many economic plants. The contribution apparently puts into the hands of producers one of the important means of controlling fruitfulness. FISCHER's less extensive and one-sided attack caused him to miss the fact that a very high C/N not only reduces vegetative growth but diminishes reproduction.

These papers have thrown much light on some of the nutrient factors modifying vegetation and reproduction in plants.—WM. CROCKER.

**Loss of chlorophyll.**—MEYER<sup>4</sup> notes that in *Tropaeolum majus*, growing in pots in a greenhouse, the young leaves at the top of the stem are dark green, while the progressively older ones down the stem are green, bright green, yellow

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<sup>2</sup> FISCHER, H., Zur Frage der Kohlensäure-Einahrung der Pflanzen. Gartenflora 65:232-237. 1916.

<sup>3</sup> KRAUS, E. J., and KRAYBILL H. R., Vegetation and reproduction with special reference to the tomato. Oreg. Agric. Exper. Sta. Bull. 149. pp. 90. 1918.

<sup>4</sup> MEYER, ARTHUR, Eiweisstoffwechsel und Vergilben der Laubblätter von *Tropaeolum majus*. Festschrift zum ERNST STAHL. pp. 85-127. Jena. 1918.

green, yellow and bright yellow, and finally the oldest ones on the plant are wilting. MEYER points out that this change in color is due to the gradual decomposition of the chlorophylls, while the carotin and xanthophyll remain constant. As this change progresses the chloroplasts become smaller, and in later stages are shriveled granular masses with balls of excreted material about them. With the gradual loss of chlorophyll goes a similar decomposition of the proteins of the chloroplast. It should be mentioned that MEYER adduces evidence for the view that the chloroplast is the main organ for the storage of the proteins manufactured in the foliage leaf, if indeed not the very seat of protein manufacture. The amount of carbohydrates in the leaves also falls with age. MEYER found that when leaves are placed in darkness no reduction occurs in the proteins until the carbohydrates are greatly reduced by respiration. The decomposition of the proteins then begins, he believes, as a source of carbon chains for respiration. He states that there is no loss of nitrogen from the leaf during this change, but that the nitrogen residue remains in the leaf, while the carbon chain of the protein is used for respiration. He apparently gives the following interpretation of the process: As the leaves become older they become weakened; in this weakened condition the photosynthetic power falls; this leads to a great reduction in the amount of carbohydrates in the leaf, and finally to the decomposition of the proteins of the chloroplasts as a carbon source for respiration; this decomposition of the proteins is accompanied by the decomposition of the chlorophyll and the change in color.

SCHERTZ, in an unpublished work from this laboratory, finds in many respects parallel behavior in *Coleus Blumei*. He finds that shortage of nitrates leads to the decomposition of the chlorophyll, and that old leaves can be maintained green by addition of nitrogen fertilizer. He also finds the phospholipine content of the leaf greatly reduced as yellowing progresses. His evidence seems good that shortage of nitrogen initiates all of the decomposition of nitrogen compounds (chlorophyll, phospholipines, and proteins), and that it must be looked at as the immediate cause of the loss of chlorophyll. Plants grown in pots are likely to become pot bound and limited in their supply of soil nutrients.

There are many incompletely worked phases in MEYER's paper; he has filled in some gaps by drawing data from other workers on very different materials; and his work leaves much to be desired in quantitative determinations and cultural experiments. All these leave interpretation to bridge broad chasms, and it is therefore not strange if he has missed the initiating cause of loss of chlorophyll.

If SCHERTZ is right, that the decomposition of chlorophyll in *Coleus Blumei* is due to shortage of nitrogen as a building material, it is also conceivable that a great excess of nitrogen may sometimes lead to the decomposition of chlorophyll due to the dearth of carbon chains produced by the excess of nitrogen. Shortage of magnesium as a building material may sometimes act in a similar way.—WM. CROCKER.